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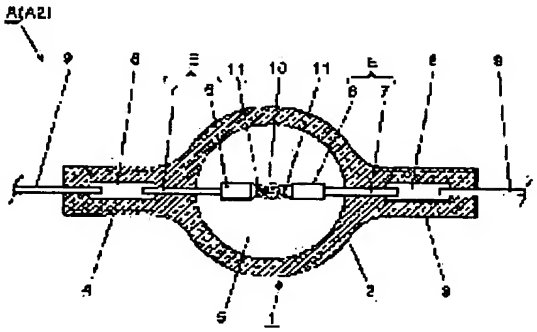
(54) LAMP ELECTRODE AND HIGH PRESSURE MERCURY LAMP USING THE ELECTRODE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a light source that satisfies any of the performance of high efficiency, long life and non-flickering.
SOLUTION: This is a lamp electrode E constructed of an electrode head 6 of a large diameter and an electrode axis 7 of a small diameter that protrudes integrally from the electrode head 6. The top end part of the electrode head 6 that is positioned on the other side of the electrode axis 7 is formed in a truncated cone shape that becomes gradually thinner toward the top end, and the top end of the truncated cone 62 is formed in a spherical surface.



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CLAIMS

[Claim(s)]
[Claim 1] An electrode for lamps characterized by being formed in the shape of [to which the amount of / which is located in the opposite side of said electrode shaft in an electrode for lamps which consisted of narrow diameter electrode shafts which protruded in one from an electrode arm head and an electrode arm head of a large diameter / of an electrode arm head / point becomes so gradually thin that it goes at a tip] an approximate circle frustum, and forming a tip of said truncated-cone portion in the spherical surface.
[Claim 2] An electrode for lamps characterized by a cone angle of a truncated-cone portion of claim 1 being 20 degrees - 60 degrees.
[Claim 3] An electrode for lamps with which relation between a diameter at the maximum equator of claim 1 or a spherical-surface portion of 2 and lamp power is characterized by being 0.0015 <=d/W<=0.005.
[Claim 4] An envelope which has the closure section to both ends of a discharge container An electrode for lamps given in claim 1 thru/or any of 3 they are [which consisted of narrow diameter electrode shafts which were arranged so that an electrode arm head might counter the interior of said discharge container, were drawn from said electrode arm head in one, and were embedded in the closure section] It is the high-pressure mercury lamp for alternating current lighting equipped with the above, and is characterized by enclosing mercury of three or more [0.2mg //mm], necessity gas, and or more 1.1x10 to 4 three or less [3.2x10 to 3 micro mol //mm] halogen with said discharge container.
[Claim 5] A high-pressure mercury lamp for alternating current lighting characterized by materializing relation of 0.75xI<=DxL<=2.9xI in a high-pressure mercury lamp for alternating current lighting of claim 4 when the length of D and an electrode arm head is set [the tube electric current] to L for the maximum outer diameter of I A and an electrode arm head.
[Claim 6] In an envelope list which has the closure section to both ends of a discharge container, inside said discharge container It is arranged so that an electrode arm head of cathode given in any [an electrode arm head of an anode plate in which a tip was formed in the shape of the spherical surface, claim 1, or] of 3 they are may counter. It is the high-pressure mercury lamp for direct-current lighting which has an electrode for lamps which consisted of narrow diameter electrode shafts which were drawn from said two-electrodes arm head in one, and were embedded in the closure section. In said discharge container Mercury of three or more [0.2mg //mm], A high-pressure mercury lamp for direct-current lighting characterized by enclosing necessity gas, and or more 1.1x10 to 4 three or less [3.2x10 to 3 micro mol //mm] halogen.
[Claim 7] In a high-pressure mercury lamp for direct-current lighting of claim 6 the tube electric current I A, When the length of D2 and an electrode arm head of an anode plate is set [the maximum outer diameter of an electrode arm head of cathode / the length of D1 and an electrode arm head of cathode] to L2 for the maximum outer diameter of L1 and an electrode arm head of an anode plate, A high-pressure mercury lamp for direct-current lighting characterized by materializing relation of 0.75xI<=D1xL1<=2.9xI and 3xI<=D2xL2 <=5xI.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the high-pressure mercury lamp which used the new electrode for lamps, and this electrode.
[0002]
[Description of the Prior Art] In recent years, the demand of a high-pressure mercury lamp which realized flicker loess has been increasing to the further well head and the further long lasting list as the light source for projectors. At present, efficient and the high-pressure mercury lamp which is satisfied with coincidence of all of long lasting and the demand which there is relation of trade-off that other engine performance will fall between flicker loess if priority is given to which engine performance and it is raised, and is these three have come to be completed to this demand.
[0003] In order to make a high-pressure mercury lamp efficient, mercury density of the light source is made or more [0.2mg //mm] into three, and the luminescent-spot temperature of the arc also reaches 7500k. Usually, in the light source whose mercury density is about [0.1mg //mm] three, luminance temperature is about 6000k. therefore, the electrode (the case of an alternating current -- two electrodes --) of the efficient high-pressure-mercury-lamp lamp with which luminance temperature reaches also more than 7500k The thermal burden which is placed on the discharge origin portion of cathode in a direct current is very severe. It fuses near the discharge origin of an electrode by this severe thermal burden, and the configuration deformation near the discharge origin, for example, configuration deformation which is referred to as the amount of [of the sharp electrode] point melting, and becoming round with surface tension, will be caused at the same time many tungstens evaporate. Moreover, many tungstens which evaporated adhere to the inside of a discharge container, cause early melanism, and cause early quantity of light attenuation. This is one cause of the short life of a lamp.
[0004] first, melanism -- a problem -- melanism -- although a lot of halogens corresponding to conveying the tungsten which evaporates so much as mentioned above for the purpose of prevention must be enclosed, the halogen concentration results in the large quantity of 3 mm 4x10 to 3 micro mol /. Therefore, at the time of lighting, fluctuation of the arc by the convection current in an electrode container is seen, and the flicker which considers this as a cause is checked on a screen.
[0005] Moreover, as mentioned above, configuration deformation [exhausting] of an electrode point are intense, and if the discharge distance between the counterelectrodes set up in early stages spreads at an early stage, the quantity of light which can be used effectively in combination with a reflector will become less extremely, and it will also become causing early quantity of light attenuation like the above-mentioned. Furthermore, if it explains in full detail, in a certain kind of optical instrument, there will be opening which the light called the LCD panel passes, and the image of the LCD panel will project on a screen. Therefore, since the light used effectively among the light which came out of the light source does not pass opening of the LCD panel, the other light does not pass opening of the LCD panel and it does not reach on a screen, it becomes meaningless. It is the phenomenon in which the light which does not pass opening of the LCD panel will increase if discharge distance spreads as mentioned above, and a screen becomes dark.

[0006] Moreover, about the problem [exhausting / electrode], as shown in drawing 6 , the tungsten coil (26a) which makes the work as a heat sink wound at the tip of the thin electrode (26) of an electrode (e) is enlarged, many heat capacities are taken, and the measures which lessen tungsten evaporation are also taken. However, as this cure, in a discharge-starting initial stage, it has an edge, and it winds and volume initiation of a coil with small mass or especially discharge starting which it is from an end edge (26b) is seen. the cure this will promote tungsten evaporation of the portion (26b) of a tungsten coil (26a) concerned, and according to coiling -- the melanism of a discharge container -- it did not become decisive

as a solution in question.
[0007] Although the way only an electrode arm head (36) enlarges a diameter and makes an electrode arm head (36) cylindrical [a large diameter] like drawing 7 about the attempt of others to the problem [exhausting / electrode] has also been taken Since the opposed face of an electrode arm head (36) was a plane, the discharge origin (37) moved about on the always big pair Kohei side (38), and this became fluctuation of an arc, became CHIRATSUKI on a screen, and appeared, and it was not able to be said as a desirable cure in this case.
[0008]
[Problem(s) to be Solved by the Invention] The 1st solution technical problem of this invention is to develop a new electrode for high-pressure mercury lamps which is satisfied with coincidence of any engine performance of flicker loess in it being long lasting with it being efficient, and the 2nd solution technical problem is developing the high-pressure mercury lamp which is satisfied with using this electrode of any engine performance of flicker loess in it being long lasting with it being efficient at coincidence.
[0009]
[Means for Solving the Problem] "Claim 1" is the basic form of an electrode for lamps concerning this invention (E). An electrode arm head of a "(a) large diameter (6), It is the electrode for lamps (E) which consisted of electrode arm heads (6) with a narrow diameter electrode shaft (7) which protruded in one. (b) It is characterized by" thing by which it is formed in the shape of [to which the amount of / which is located in the opposite side of said electrode shaft (7) / of an electrode arm head (6) / point becomes so gradually thin that it goes at a tip] an approximate circle frustum, and a tip of said truncated-cone portion (62) is formed in the spherical surface.
[0010] If a part for a point of an electrode arm head (6) is formed in the shape of an approximate circle frustum An electrode arm head (6) holding mass sufficient as a heat sink by truncated-cone portion (62) at a tip Area of a spherical-surface portion (63) at a tip of a truncated-cone portion (62) in which a discharge origin (11) of an arc is located becomes [a rat tail and a generating origin (11)] is easy to be limited to a spherical-surface portion (63), and an arc will be stabilized. It seems that in addition, an elutriation base (64) is extracted [a spherical-surface portion (63) at a tip] for a solid sphere portion like drawing 5 like drawing 4 like drawing 3 according to a shaping condition as a configuration of a spherical-surface portion (63), for example in the case of a semi-sphere when like [of a ball or a spheroid / a part of], and it may have connected in [a part / a truncated-cone portion (62)] one. Of course, also when other, it contains. When it thinks from a field of heat transfer of a spherical-surface portion (63), drawing 3 and a case of 4 are desirable.
[0011] "Claim 2" is characterized by what "a cone angle (theta) of said truncated-cone portion (62) is 20 degrees - 60 degrees" about a cone angle (theta) of a truncated-cone portion (62) of claim 1. When a cone angle (theta) is 20 degrees or less, a truncated-cone portion (62) becomes long and slender too much, during lighting, the amount of [of a truncated-cone portion (62)] point melts, and inter-electrode distance is expanded. On the contrary, when a cone angle (theta) is 60 degrees or more, a truncated-cone portion (62) is too short, an arc may fly to a truncated-cone portion (62), and a problem arises at the stability of an arc. When a cone angle (theta) is in said range, an arc is stabilized and generated into a ****** spherical-surface portion (63). Melting and evaporation of a truncated-cone portion (62) of an electrode arm head (6) are controlled by making it said range, and a stable lighting condition is acquired.
[0012] "Claim 3" is characterized by what "said relation is 0.0015 <=(d1)/(W) <=0.005" about relation between a diameter at the maximum equator of claim 1 or a spherical-surface portion of 2, and lamp power. To lamp power (W), a spherical-surface portion (63) melts at the time of lighting as too little [a diameter at the maximum equator (d1) of a spherical-surface portion (63)], inter-electrode distance becomes large, an arc becomes unstable, or evaporation of an electrode constituent increases and problems, such as causing melanism, generate a diameter at the maximum equator (d1) of a spherical-surface portion (63), and relation of lamp power (W). On the other hand, a generating origin (11) of an arc is not fixed to lamp power (W) in a diameter at the maximum equator (d1) of a spherical-surface portion (63) being excessive, a spherical-surface portion (63) is moved, and it becomes the cause of CHIRATSUKI. When "/ (W) (d1)" is in said range, an arc is stabilized, and melting and evaporation of a truncated-cone portion (62) of an electrode arm head (6) are controlled, and a stable lighting condition is acquired.
[0013] An envelope to which "claim 4" has the closure section (3) and (4) to both ends of "refer to drawing 1 " and a discharge container (2) about a high-pressure mercury lamp for alternating current lighting (A1) which used said electrode for lamps (E) (1), It is arranged so that an electrode arm head (6) may counter the interior of said discharge container (2). It is the high-pressure mercury lamp for alternating current lighting (A1) which has an electrode for lamps (E) given in claim 1 thru/or any of 3 they are. [which consisted of narrow diameter electrode shafts (7) which were drawn from said electrode arm

head (6) in one, and were embedded the closure section (3) and (4)] It is characterized by enclosing mercury of three or more [0.2mg //mm], necessity gas, and or more 1.1x10 to 4 three or less [3.2x10 to 3 micro mol //mm] halogen with said discharge container (2).

[0014] When the amount of mercury is three or less [0.152mg //mm], brightness and color rendering properties are inadequate and high brightness and high color rendering properties can be secured because 0.2mg /makes [more / mm] the amount of mercury than 3. In order to acquire high brightness and color rendering properties, if such a high amount of mercury is enclosed with a discharge container (2), arc temperature will also reach 7500k. although a thermal burden placed on an electrode (-E) (+E) becomes large, evaporation of an electrode constituent (tungsten) will increase, this will adhere to an inside of a discharge container (2) and melanism will be caused -- melanism -- it will be called the range of the above [proper halogen concentration required for transportation of quality of an emission] for prevention.

[0015] That is, when halogen concentration is three or less [1.1x10 to 4 micro mol //mm], a halogen cycle too little [traffic of quality of an emission] and normal is checked, and melanism cannot be prevented, but a lamp life becomes short. On the contrary, corrode an electrode (E), when halogen concentration is three or more [3.2x10 to 3 micro mol //mm], when excessive, breakage of an electrode shaft (7) is made generated, fluctuation of an arc by intense convection-current generating within a discharge container (2) is caused, and it is made for a flicker under lighting to be produced. And magnitude [arc] of fluctuation becomes large with an increment in halogen concentration. It could check on a screen clearly 3.3x10 to 4 micro mol/mm 3 in 500 hours, and has checked mm 7x10 to 3 micro mol /3 in only 100 hours. This worsens an image on a screen. In addition, as necessity gas, argon gas, xenon gas, or these mixed gas is used if needed.

[0016] Next, although it is the amount of mercury and halogen concentration, and relation with an electrode arm head (6) Since a large diameter portion (61) of an electrode arm head (6) has sufficient mass, work as a heat sink is fully achieved. Since luminescent-spot temperature which also reaches 7500k by flood silver content can be borne enough, evaporation of an electrode constituent can be controlled, and the tip configuration is formed in the shape of an approximate circle frustum and a rat tail and also its tip are formed in the spherical surface A generating origin (11) of an arc becomes as mentioned above that it is easy to be limited to a spherical-surface portion (63), and an arc will be stabilized. Severe lighting conditions under the above-mentioned flood silver content can be borne by this, and a longevity life can be obtained.

[0017] "Claim 5" is what limited further a high-pressure mercury lamp for alternating current lighting of claim 4 (A1), and is characterized by what "relation of 0.75xI<=DxL<=2.9xI is materialized for when the length of D and an electrode arm head (6) is set [the tube electric current] to L for the maximum outer diameter of I A and an electrode arm head (6)."

[0018] The above "DxL" shows magnitude of an electrode arm head (6), temperature of an electrode arm head (6) falls too much that magnitude of an electrode arm head (6) is excessive to the tube electric current to an electrode arm head (6), going out of an arc produces it, heat capacity is inadequate in too little, and evaporation of an electrode constituent at the time of lighting increases. If "DxL" is in said range, there is also no going out of an arc and evaporation of an electrode constituent can also be controlled.

[0019] "Claim 6" is related with a high-pressure mercury lamp for direct-current lighting (A2) which used said electrode for lamps (E). In an envelope (1) list which has the closure section (3) and (4) to both ends of discharge container (2), "inside said discharge container (2) It is arranged so that an electrode arm head (6) of cathode (- E) given in any [an electrode arm head (6) of an anode plate (+E) in which a tip was formed in the shape of the spherical surface, claim 1, or] of 3 they are may counter. It is the high-pressure mercury lamp for direct-current lighting (A2) which has an electrode for lamps (- E) (+E) which consisted of narrow diameter electrode shafts (7) which were drawn from said two-electrodes arm head (6) in one, and were embedded the closure section (3) and (4). It is characterized by" thing by which mercury of three or more [0.2mg //mm], necessity gas, and or more 1.1x10 to 4 three or less [3.2x10 to 3 micro mol //mm] halogen are enclosed with said discharge container (2).

[0020] In this case, a configuration and energization conditions of cathode (- E) and an anode plate (+E) are only different, and a fundamental configuration is the same as said object for an alternating current. Therefore, the amount of mercury, necessity gas, halogen concentration, etc. are the same, and the same is said of the operation. Although a lamp electrode (E) according to claim 1 to 3 is used for cathode (-E) Although an anode plate (+E) may use a lamp electrode (E) according to claim 1 to 3 since it is a receptacle side of an arc, it is not necessary to use this specially, there may not be a portion of a truncated-cone portion (62), and a tip of a large diameter portion (61) of an electrode arm head (6) may become spherical surface-like. The latter is used in this example mentioned later.

[0021] In addition, (+) and (-) are given to (E) which is the sign which expresses an electrode with a high-

pressure mercury lamp for direct-current lighting (A2) since cathode (- E) and an anode plate (+E) are different configurations, and an anode plate and cathode are distinguished.
[0022] "Claim 7" is the further limitation of a high-pressure mercury lamp for direct-current lighting of claim 6 (A2). "When the length of D2 and an electrode arm head (6) of an anode plate (+H) is set [the tube electric current / the maximum outer diameter of I A and an electrode arm head (6) of cathode (- E) / the length of D1 and an electrode arm head (6) of cathode (- E)] to L2 for the maximum outer diameter of L1 and an electrode arm head (6) of an anode plate (+E), It is characterized by" thing in which relation of 0.75xI<=D1xL1<=2.9xI and 3xI<=D2xL2 <=5xI is materialized.
[0023] The above "D1xL1" and "D2xL2" show magnitude of each electrode arm head (6) like the above-mentioned, and they are as the above-mentioned [relation of the tube electric current over an electrode arm head (6)]. That is, temperature of an electrode arm head (6) falls too much that magnitude of an electrode arm head (6) is excessive to the tube electric current, going out of an arc arises, heat capacity is inadequate in too little, and evaporation of an electrode constituent at the time of lighting increases. If "D1xL1" and "D2xL2" are in said range, there is also no going out of an arc and evaporation of an electrode constituent can also be controlled. In addition, in for a direct current, it attached to "D" and "L", it attached a numeric character "1" and "2", and distinguished polarity.
[0024]
[Embodiment of the Invention] Hereafter, this invention is explained using a suitable example. Drawing 1 is drawing having shown the high-pressure mercury lamp for an alternating current concerning this example (A1). An envelope (1) consists of the closure section (3) of the ** length who projected from the discharge container (2) with which necessity gas, such as argon gas, xenon gas, or these mixed gas, mercury, a halogen (it is enclosed in the form of a metal halogen, or it is in a form like halogenation mercury or a methylene bromide, and enclosed.), etc. were enclosed, and its both ends, and (4).
[0025] In the discharge container (2), the electrode made from the tungsten of the pair which counters (E) is arranged, and the narrow diameter electrode shaft (7) of an electrode (E) is welded to the end section of a molybdenum foil (8). And an external lead (9) is welded to the other end of said molybdenum foil (8), and it is drawn from the closure section (3) and (4). The wolfram electrode (E) of this invention is one began to delete an electrode shaft (7) from the tungsten rod of a large diameter, and the diameter of an electrode shaft (7) has become 50% - about 30% of the large diameter portion (61) of an electrode arm head (6). In addition, since the thing of the same configuration was usually used, the electrode (E) of the high-pressure mercury lamp for an alternating current (A1) attached and expressed the same number.
[0026] The example of the electrode (E) of said high-pressure mercury lamp for an alternating current (A1) is shown in drawing 3 -5. Although these carry out a ****** difference in the configuration of a spherical-surface portion (63), they are fundamentally constituted by the narrow diameter electrode shaft (7) which protruded in one from the electrode arm head (6) and electrode arm head (6) of a large diameter. And it is formed in the shape of [to which the amount of / which is located in the opposite side of said electrode shaft (7) / of an electrode arm head (6) / point becomes so gradually thin that it goes at a tip] an approximate circle frustum, and the tip of said truncated-cone portion (62) is formed in the spherical surface. The cone angle (theta) of the cone angle (theta) of a truncated-cone portion (62) is 20 degrees - 60 degrees. In addition, the slant face of a truncated-cone portion (62) is not restricted to a straight line, but the bus-bar may be drawing the concave curve or the convex curve.
[0027] The spherical-surface portion (63) for a point of said truncated-cone portion (62) carries out cutting of the part for the point of for example, an electrode arm head (6) to the shape of a cone, fuses the tip of the cone portion (65), and is formed by making it the shape of the spherical surface with the surface tension. In this case, that configuration is different with the cone angle (theta) of a cone portion (65), and the difference in the amount of melting. It is a case as drawing 3 has few amounts of melting at a tip, it is in the condition of which drawing 5 had too many amounts of melting at a tip, and the spherical-surface portion (63) jumped out when a spherical-surface portion (63) was a case [like / a part of], the amount of melting of drawing 4 at a tip was proper and it was a semi-sphere, the base (64) is narrow a little and a part of spherical-surface portion (63) has connected with a truncated-cone portion (62) in one That is, it becomes the diameter (d2) < diameter at the maximum equator (d1) of a base (64). Of course, the configuration of a spherical-surface portion (63) has a cylindrical portion (not shown) in the portion of the base (64) which is not restricted to this, for example, stands in a row in one at the tip of a truncated-cone portion (62), and also when the tip is formed in the spherical surface, it is included. Naturally the configuration of said spherical-surface portion (63) does not need to be a perfect circle, and it cannot be overemphasized that irregularity may be shown in the surface.
[0028] Between said spherical-surface portions (63) and lamp power (W), relation "0.0015 <=(d1)/(W) <=0.005" 0.005 [which determines the proper value of a spherical-surface portion (63)] Unrelated is

drawn experimentally. It is "0.0025 <=(d1)/(W) <=0.0035" more preferably. Here, (d1) is the diameter at the maximum equator of a spherical-surface portion (63). The unit of lamp power (W) is watt. Moreover, the relation which determines magnitude with a proper electrode arm head (6) also between the tube electric current and the magnitude of an electrode arm head (6) is drawn experimentally. This relation is experimentally made sure that it is desirable that it is in the range of "0.75xI<=DxL<=2.9xI", when the length of D and an electrode arm head (6) is set to L for the maximum outer diameter.

[0029] The amount of mercury enclosed with said discharge container (2) is three or more [0.2mg //mm], and halogen concentration is three or less [3.2x10 to 3 micro 1.1xten to four or more mols //mm]. Halogen concentration is expressed with ion concentration.

[0030] Next, it attaches and explains to the operation at the time of alternating current lighting. In the external lead rod (9) of a pair, if alternating voltage is impressed, between counterelectrodes (E), by turns, an arc will fly and will be ignited. Although an arc flies toward the electrode (E) impressed to plus from the spherical-surface portion (63) at the tip of the electrode (E) impressed to minus, generally an arc flies between the nearest portions of the spherical-surface portion (63) at the tip of both counterelectrodes (E). Since a part for a point is extracted since the truncated-cone portion (62) is formed in a part for the point of both counterelectrodes (E), and the spherical-surface portion (63) is formed at the tip, abbreviation limitation is carried out between spherical-surface portions (63), and an arc will be stabilized and will fly. As a result, an arc is stabilized and CHIRATSUKI is canceled.

[0031] If an arc flies between spherical-surface portions (63), a spherical-surface portion (63) is begun, the electrode base (6) is quickly heated with the heat of an arc, and if it is in the discharge container (2) with which the amount of mercury of three or more [0.2mg //mm] was enclosed, the luminescent-spot temperature of an arc will also reach 7500k. consequently, the electrode arm head (6) which carries out operation sufficient as a heat sink with mass with the sufficient heat of a spherical-surface portion (63) although the spherical-surface portion (63) near the luminescent spot (10) of an arc is put to the high temperature and becomes an elevated temperature -- it is transmitted to especially a large diameter portion (61), and the temperature rise of a spherical-surface portion (63) is controlled. Since an original configuration will be the spherical surface-like even if the surface fuses a little said spherical-surface portion (63) put to the elevated temperature during lighting, the configuration does not change a lot. (For example, if a tip is a triangular pyramid-like electrode, when the portion of a triangular pyramid melts, a tip will become round and a tip configuration will change sharply.) Therefore, even if the surface of a spherical-surface portion (63) fuses a little during lighting, stable arcing is maintained so that inter-electrode distance may not change.

[0032] When a spherical-surface portion (63) is a configuration [like / of a solid sphere or a spheroid / a part of] like drawing 3 , like drawing 4 , hemispherical or migration of the heat to the large diameter portion (61) which makes the main work as a heat sink through a truncated-cone portion (62) from a spherical-surface portion (63) when it is a half-spheroid-like is performed smoothly, and it is easy to avoid overheating of a spherical-surface portion (63) here. Since the spherical-surface portion (63) is not in the condition of having projected from the truncated-cone portion (62) like drawing 5 on the other hand, it is thought that there is more probability for an arc to fly to the truncated-cone portion (62) of the electrode by the side of plus (E) a little than the case of drawing 5 .

[0033] On the other hand, since it is in a condition which the spherical-surface portion (63) projected from the truncated-cone portion (62) in the case of drawing 5 Since drawing 3's and the area's of the spherical-surface portion (63) to which an arc's flies compared with the case of 4 being large, and a spherical-surface portion (63) have projected from the truncated-cone portion (62) Since the spherical-surface portions (63) which countered compared with the truncated-cone portion (62) will be approached more, an arc becomes easier to fly between spherical-surface portions (63). Since it will be in the condition that the base (64) of a spherical-surface portion (63) was extracted, on the other hand, a base (64) serves as a neck, migration of the heat to a large diameter portion (61) will be overdue a little compared with drawing 3 and 4, and it is in the orientation for a spherical-surface portion (63) to become that it is easy to be overheated a little. Anyway, since the original configuration of the spherical-surface portion (63) of the electrode (E) of drawing 3 -5 is the spherical surface-like, the configuration does not change a lot and change of the inter-electrode distance under lighting will become very small.

[0034] Next, the ** high-pressure mercury lamp for a direct current (A2) is explained according to drawing 2 . In order to avoid the complicatedness of explanation, the same portion as the high-pressure mercury lamp for an alternating current (A1) attaches the same sign, and explains it focusing on a different portion. Different portions are only that the configuration of an electrode (- E) (+E) differs from it of the high-pressure mercury lamp for an alternating current (A1), and the point that electron flow follows an anode plate (+E) and flows from cathode (- E). Other points are the same as the high-pressure mercury lamp for

an alternating current (A1).
[0035] Although what has cathode (-E) the same as the object for an alternating current is used, in order for a thermoelectron to collide with the opposed face (12) of an anode plate (+E) and to always overheat an anode plate (+E), as for an anode plate (+E), compared with cathode (-E), what has large mass is prepared during lighting. On the other hand, although the hot luminescent spot (10) appears near the spherical-surface portion (63) of cathode (- E) and a spherical-surface portion (63) is heated, since it becomes local heating, it is the thing of mass smaller than an anode plate (+E), and is sufficient.
[0036] Although the thing of the configuration same as mentioned above as the object for an alternating current is sufficient as the configuration of an anode plate (+E), since a thermoelectron is only received continuously, in a direct current, an electrode (6a) with which there is no truncated-cone portion (62), and the direct spherical-surface portion (63) is formed at the tip of a large diameter portion (61) is sufficient. In the case of drawing 2 , the latter electrode arm head (6a) is adopted.
[0037] Next, it attaches and explains to the operation at the time of direct-current lighting. If the external lead rod (9) of a pair is impressed, from an anode plate side (- E), an arc will fly and will be ignited at a cathode (+E) side. Generally also in this case, an arc flies in the nearest portion between the spherical-surface portion (63) at the tip of both counterelectrodes (- E) (+E), and (12). Since a truncated-cone portion (62) is formed as mentioned above, and a part for the point is extracted and, as for a part for the point of cathode (-E), the spherical-surface portion (63) is formed at the tip, the origin (11) of an arc occurs stably within a spherical-surface portion (63), and migration of an arc is canceled.
[0038] Like the case of an alternating current, since the amount of mercury of three or more [0.2mg //mm] is enclosed, if an arc generates a spherical-surface portion (63) on a spherical-surface portion (63), the spherical-surface portion (63) of cathode (- E) will be heated by the hot luminescent spot (10). however, the electrode arm head (6) which carries out operation sufficient as a heat sink with mass with the sufficient heat of a spherical-surface portion (63) -- it is transmitted to especially a large diameter portion (61), and the temperature rise of a spherical-surface portion (63) is controlled. And since an original configuration will be the spherical surface-like even if the surface fuses a little said spherical-surface portion (63) put to the elevated temperature like the case of an alternating current during lighting, the configuration does not change a lot.
[0039] On the other hand, in an anode plate (+E) side, since the opposite apical surface (12) of an electrode arm head (6a) is formed in the spherical surface, an arc flies stably toward the crowning of an opposite apical surface (12) in general. Thus, an arc is stabilized according to a collaboration operation of the cathode (+E) which has a spherical-surface portion (63) in a truncated-cone portion (62) and its opposite point, and an anode plate (+E) with the spherical-surface section (12), and it generates. Moreover, change of the inter-electrode distance under lighting as well as the case of an alternating current will become very small.
[0040]
[Effect of the Invention] As stated above, by this invention, the light source with which it is satisfied of any engine performance of flicker loess in it being long lasting with it being efficient was able to be offered. .

[Translation done.]

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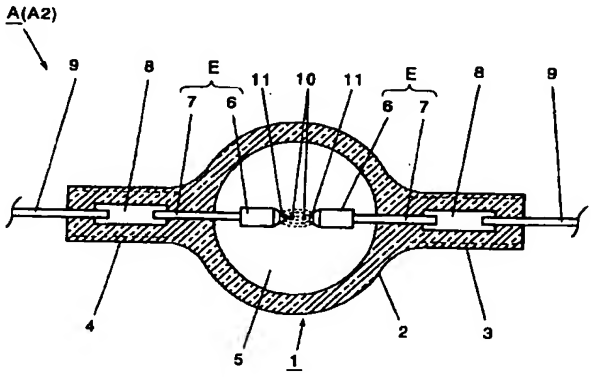
(54)【発明の名称】　ランプ用電極と該電極を使用した高圧水銀ランプ

(57)【要約】
【課題】　高効率と長寿命とフリッカーレスのいずれの性能も満足する光源を提供する。
【解決手段】　太径の電極ヘッド(6)と、電極ヘッド(6)から一体的に突設された細径の電極軸(7)とで構成されたランプ用電極(E)であって、(b)　前記電極軸(7)の反対側に位置する電極ヘッド(6)の先端部分が、先端に行く程次第に細くなる略円錐台状に形成され且つ前記円錐台部分(62)の先端が球面に形成されている事を特徴とする。



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【特許請求の範囲】

【請求項１】　太径の電極ヘッドと、電極ヘッドから一体的に突設された細径の電極軸とで構成されたランプ用電極において、

前記電極軸の反対側に位置する電極ヘッドの先端部分が、先端に行く程次第に細くなる略円錐台状に形成され且つ前記円錐台部分の先端が球面に形成されている事を特徴とするランプ用電極。

【請求項２】　請求項１の円錐台部分のテーパ角度が20°～60°となっている事を特徴とするランプ用電極。

【請求項３】　請求項１又は２の球面部分の最大直径とランプ電力との関係が、$0.0015 \leqq d/W \leqq 0.005$である事を特徴とするランプ用電極。

【請求項４】　放電容器の両端に封止部を有する外囲器と、前記放電容器の内部に電極ヘッドが対向するように配設され、前記電極ヘッドから一体的に導出され、封止部に埋入された細径の電極軸とで構成された請求項１乃至３の何れかに記載のランプ用電極とを有する交流点灯用高圧水銀ランプにおいて、

前記放電容器には$0.2mg/mm^3$以上の水銀、

必要ガス及び、

1.1×10^{-4}以上3.2×10^{-3} $\mu mol/mm^3$以下のハロゲンとが封入されている事を特徴とする交流点灯用高圧水銀ランプ。

【請求項５】　請求項４の交流点灯用高圧水銀ランプにおいて、

管電流をＩアンペア、電極ヘッドの最大外径をＤ、電極ヘッドの長さをＬとしたとき、$0.75\times I \leqq D\times L \leqq 2.9\times I$の関係が成立することを特徴とする交流点灯用高圧水銀ランプ。

【請求項６】　放電容器の両端に封止部を有する外囲器並びに前記放電容器の内部に、先端が球面状に形成された陽極の電極ヘッドと請求項１乃至３の何れかに記載の陰極の電極ヘッドとが対向するように配設され、前記両電極ヘッドから一体的に導出され、封止部に埋入された細径の電極軸とで構成されたランプ用電極を有する直流点灯用高圧水銀ランプであって、

前記放電容器には$0.2mg/mm^3$以上の水銀と、

必要ガスと、

1.1×10^{-4}以上3.2×10^{-3} $\mu mol/mm^3$以下のハロゲンとが封入されている事を特徴とする直流点灯用高圧水銀ランプ。

【請求項７】　請求項６の直流点灯用高圧水銀ランプにおいて、

管電流をＩアンペア、陰極の電極ヘッドの最大外径をD_1、陰極の電極ヘッドの長さをL_1、陽極の電極ヘッドの最大外径をD_2、陽極の電極ヘッドの長さをL_2とした時、$0.75\times I \leqq D_1\times L_1 \leqq 2.9\times I$及び$3\times I \leqq D_2\times L_2 \leqq 5\times I$の関係が成立する事を特徴とする直流点灯用高圧水銀ランプ。

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【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、新規なランプ用電極及び該電極を使用した高圧水銀ランプに関するものである。

【０００２】

【従来の技術】近年、プロジェクター用光源として、更なる高効率と長寿命並びにフリッカーレスを実現した高圧水銀ランプの要求が高まってきている。この要求に対し、高効率、長寿命及びフリッカーレスとの間には、何れかの性能を優先して向上させると他の性能が低下するというトレードオフの関係があり、これら３つの要求を全て同時に満足する高圧水銀ランプは現時点では完成するに至っていない。

【０００３】高圧水銀ランプを高効率とするために、光源の水銀密度は$0.2mg/mm^3$以上とされ、そのアークの輝点温度は7500ｋにも達する。通常、水銀密度が$0.1mg/mm^3$程度の光源では、輝度温度は6000ｋ程度である。従って、輝度温度が7500ｋ以上にも達する高効率の高圧水銀ランプランプの電極（交流の場合は両電極、直流の場合は陰極）の放電起点部分にかかる熱的負担は非常に過酷なものであり、過酷なこの熱的負担により電極の放電起点近傍が溶融し、多くのタングステンが蒸発すると同時に放電起点近傍の形状変形、例えば尖っていた電極の先端部分が溶けて表面張力で丸くなると言うような形状変形を引き起こす事になる。また、蒸発した多くのタングステンは放電容器の内面に付着して早期の黒化を招き、早期の光量減衰を招く。これがランプの短寿命の１つの原因である。

【０００４】まず、黒化問題については、例えば黒化防止の目的で前述のように多量に蒸発するタングステンを輸送するのに見合う多量のハロゲンを封入しなければならないが、そのハロゲン濃度は4×10^{-3} $\mu mol/mm^3$もの多量に至る。そのため点灯時、電極容器内の対流によるアークの揺らぎが見られ、これを原因とするフリッカがスクリーン上で確認される。

【０００５】又、前述のように電極先端部の消耗や形状変形が激しく、初期に設定された対向電極間の放電距離が早期に広がると、リフレクターとの組み合わせで有効利用できる光量が極端に減り、前述同様早期の光量減衰を招く事にもなる。更に詳述すれば、ある種の光学機器では、ＬＣＤパネルと呼ばれる光が通過する開口部があり、ＬＣＤパネルの画像がスクリーン上に映し出される。従って、光源から出た光の内、有効利用される光はＬＣＤパネルの開口部を通過するものだけであり、それ以外の光はＬＣＤパネルの開口部を通過せず、スクリーン上に到達しないので、無意味になる。前述のように放電距離が広がるとＬＣＤパネルの開口部を通過しない光が増加し、スクリーンが暗くなる現象である。

【０００６】また、電極消耗問題については、図６に示

すように電極(e)の細い電極棒(26)の先端に巻着されたヒートシンクとしての働きをなすタングステンコイル(26a)を大きくして熱容量を多く取り、タングステン蒸発を少なくする対策も取られている。しかしこの対策では放電開始初期段階において、エッジを有し、質量の小さいコイルの巻き開始或いは巻き終わり端部(26b)からの放電開始が特に見られる。このことはタングステンコイル(26a)の当該部分(26b)のタングステン蒸発を促進することになり、コイル巻きによる対策は、放電容器の黒化問題の解決策としては決定的なものとはならなかった。

【０００７】電極消耗問題に対するその他の試みについては、図７のように電極ヘッド(36)のみ直径を大きくし、電極ヘッド(36)を太径の円柱状とする方法も取られて来たが、電極ヘッド(36)の対向面が平面であるため放電起点(37)が常に大きな対向平面(38)上を動き回り、これがアークの揺らぎとなりスクリーン上のチラツキとなって現れ、この場合も好ましい対策といえなかった。

【０００８】

【発明が解決しようとする課題】本発明の第１の解決課題は、高効率と長寿命とフリッカーレスのいずれの性能も同時に満足するような高圧水銀ランプ用の新規な電極を開発する事にあり、第２の解決課題は該電極を使用する事で高効率と長寿命とフリッカーレスのいずれの性能も同時に満足する高圧水銀ランプを開発する事である。

【０００９】

【課題を解決するための手段】「請求項１」は、本発明にかかるランプ用電極(E)の基本形で、「(a)　太径の電極ヘッド(6)と、電極ヘッド(6)から一体的に突設された細径の電極軸(7)とで構成されたランプ用電極(E)であって、(b)　前記電極軸(7)の反対側に位置する電極ヘッド(6)の先端部分が、先端に行く程次第に細くなる略円錐台状に形成され且つ前記円錐台部分(62)の先端が球面に形成されている」事を特徴とする。

【００１０】電極ヘッド(6)の先端部分が略円錐台状に形成されておれば、電極ヘッド(6)はヒートシンクとして十分な質量を保持しつつ先端の円錐台部分(62)によってアークの放電起点(11)が位置する円錐台部分(62)の先端の球面部分(63)の面積が絞られ且つ発生起点(11)が球面部分(63)に限定されやすくなりアークが安定する事になる。なお、球面部分(63)の形状としては、例えば、成形状態によって図３のように先端の球面部分(63)が球又は回転楕円体の一部のような場合、図４のように半球の場合、図５のように球体部分が飛び出し基部(64)が絞られて一部が円錐台部分(62)に一体的に接続しているような場合がある。勿論、それ以外の場合も含む。球面部分(63)の熱伝達の面から考えると図３，４の場合が好ましい。

【００１１】「請求項２」は、請求項１の円錐台部分(62)のテーパ角度(θ)に関し、「前記円錐台部分(62)のテーパ角度(θ)が20°～60°となっている」事を特徴とする。テーパ角度(θ)が20°以下の場合、円錐台部分(62)が細長くなり過ぎ点灯中に円錐台部分(62)の先端部分が溶けて電極間距離が拡大する。逆に、テーパ角度(θ)が60°以上の場合、円錐台部分(62)が短すぎ、円錐台部分(62)にアークが飛ぶ事があり、アークの安定性に問題が生じる。テーパ角度(θ)が前記範囲にある場合、アークはがほぼ球面部分(63)に安定して発生する。前記範囲にする事で電極ヘッド(6)の円錐台部分(62)の溶融や蒸発が抑制され、安定した点灯状態が得られる。

【００１２】「請求項３」は、請求項１又は２の球面部分の最大直径とランプ電力との関係に関し「前記関係が、0.0015≦(d1)／(W)≦0.005である」事を特徴とする。球面部分(63)の最大直径(d1)とランプ電力(W)の関係は、ランプ電力(W)に対して球面部分(63)の最大直径(d1)が過小であると、点灯時、球面部分(63)が溶けて電極間距離が大きくなりアークが不安定になったり、電極構成物質の蒸発量が増大して黒化を招くなどの問題が発生する。一方、ランプ電力(W)に対して球面部分(63)の最大直径(d1)が過大であると、アークの発生起点(11)が一定せず球面部分(63)を移動し、チラツキの原因になる。「(d1)／(W)」が前記範囲にある場合、アークが安定し且つ電極ヘッド(6)の円錐台部分(62)の溶融や蒸発が抑制され、安定した点灯状態が得られる。

【００１３】「請求項４」は、前記ランプ用電極(E)を使用した交流点灯用高圧水銀ランプ(A1)に関し「図１参照」、放電容器(2)の両端に封止部(3)(4)を有する外囲器(1)と、前記放電容器(2)の内部に電極ヘッド(6)が対向するように配設され、前記電極ヘッド(6)から一体的に導出され、封止部(3)(4)に埋入された細径の電極軸(7)とで構成された請求項１乃至３の何れかに記載のランプ用電極(E)とを有する交流点灯用高圧水銀ランプ(A1)であって、前記放電容器(2)には0.2mg/mm^{3}以上の水銀、必要ガス及び、１.１×10^{-4}以上3.2×10^{-3} μmol/mm^{3}以下のハロゲンとが封入されている事を特徴とする。

【００１４】水銀量が0.152mg/mm^{3}以下の場合、輝度と演色性が不十分であり、水銀量を0.2mg/mm^{3}より多くすることで、高い輝度と演色性とを確保する事が出来る。高輝度と演色性とを得るために、このような高い水銀量を放電容器(2)に封入するとアーク温度は7500ｋにも到達し、電極(-E)(+E)にかかる熱的負担が大きくなり、電極構成物質（タングステン）の蒸発量が多くなり、これが放電容器(2)の内面に付着して黒化を招くことになるが、黒化防止のため蒸発物質の輸送に必要な適正ハロゲン濃度が前記の範囲と言うことになる。

【００１５】即ち、ハロゲン濃度が１.１×10^{-4} μmol/mm^{3}以下の場合、蒸発物質の輸送量が過小で正常なハロゲンサイクルが阻害されて黒化を防止出来ず、ランプ寿命が短くなる。逆に、ハロゲン濃度が3.2×10^{-3} μmol/mm^{3}以上の場合は電極(E)を腐食し、甚だしい場合には電極軸(7)の折損を発生させる事になるし、放電容器(2)内で

の激しい対流発生によるアークの揺らぎを引き起こし、点灯中のフリッカーを生じさせる事になる。そして、アークの揺らぎの大きさはハロゲン濃度の増加と共に大きくなる。3.3×10^{-4} μmol／mm³では500時間ではっきりスクリーン上で確認でき、また7×10^{-3} μmol／mm³ではわずか１００時間にて確認できた。これはスクリーン上のイメージを悪化させる。なお、必要ガスとしては、アルゴンガス、クセノンガス或いはこれらの混合ガスなどが必要に応じて使用される。

【００１６】次に、水銀量及びハロゲン濃度と電極ヘッド(6)との関係であるが、電極ヘッド(6)の太径部分(61)は、十分な質量を有しているのでヒートシンクとしての働きを十分に果たし、高水銀量による7500ｋにも到達する輝点温度に十分耐え電極構成物質の蒸発を抑制する事が出来、且つその先端形状が略円錐台状に絞られ更にその先端が球面に形成されているので、前述のようにアークの発生起点(11)が球面部分(63)に限定されやすくなりアークが安定する事になる。これにより前述の高水銀量下での過酷な点灯条件に耐え、長寿命を得る事が出来る。

【００１７】「請求項５」は、請求項４の交流点灯用高圧水銀ランプ(A1)を更に限定したもので、「管電流をＩアンペア、電極ヘッド(6)の最大外径をＤ、電極ヘッド(6)の長さをＬとしたとき、$0.75\times I\leqq D\times L\leqq2.9\times I$の関係が成立する」ことを特徴とする。

【００１８】前記「Ｄ×Ｌ」は、電極ヘッド(6)の大きさを示すもので、電極ヘッド(6)に対して管電流に対して電極ヘッド(6)の大きさが過大であると電極ヘッド(6)の温度が下がりすぎてアークの立ち消えが生じ、過小であると熱容量が不十分で点灯時の電極構成物質の蒸発量が増大する。「Ｄ×Ｌ」が前記範囲にあれば、アークの立ち消えもなく電極構成物質の蒸発量も抑制する事が出来る。

【００１９】「請求項６」は、前記ランプ用電極(E)を使用した直流点灯用高圧水銀ランプ(A2)に関し、「 放電容器(2)の両端に封止部(3)(4)を有する外囲器(1)並びに前記放電容器(2)の内部に、先端が球面状に形成された陽極(+E)の電極ヘッド(6)と請求項１乃至３の何れかに記載の陰極(-E)の電極ヘッド(6)とが対向するように配設され、前記両電極ヘッド(6)から一体的に導出され、封止部(3)(4)に埋入された細径の電極軸(7)とで構成されたランプ用電極(-E)(+E)を有する直流点灯用高圧水銀ランプ(A2)であって、前記放電容器(2)には0.2mg/mm³以上の水銀と、必要ガスと、1.1×10^{-4} 以上3.2×10^{-3} μmol/mm³以下のハロゲンとが封入されている」事を特徴とする。

【００２０】この場合は、陰極(-E)と陽極(+E)の形状及び通電条件が相違するだけで、基本的構成は前記交流用と同じである。従って、水銀量、必要ガス及びハロゲン濃度などは同じであり、その作用も同じである。陰極(-E)には請求項１～３に記載のランプ電極(E)が使用されるが、陽極(+E)はアークの受け側であるから請求項１～３に記載のランプ電極(E)を使用してもよいが、別段これを使用する必要はなく、円錐台部分(62)の部分がなく、電極ヘッド(6)の太径部分(61)の先端が球面状になっているものでもよい。後述する本実施例では後者が使用されている。

【００２１】なお、直流点灯用高圧水銀ランプ(A2)では陰極(-E)と陽極(+E)とは異なる形状であるから、電極を表す符号である(E)に(+)(-)を付して陽極と陰極とを区別する。

【００２２】「請求項７」は、請求項６の直流点灯用高圧水銀ランプ(A2)の更なる限定で、「管電流をＩアンペア、陰極(-E)の電極ヘッド(6)の最大外径をD_1、陰極(-E)の電極ヘッド(6)の長さをL_1、陽極(+E)の電極ヘッド(6)の最大外径をD_2、陽極(+H)の電極ヘッド(6)の長さをL_2とした時、$0.75\times I\leqq D_1\times L_1\leqq2.9\times I$及び$3\times I\leqq D_2\times L_2\leqq5\times I$の関係が成立する」事を特徴とする。

【００２３】前記「$D_1\times L_1$」及び「$D_2\times L_2$」は、前述同様それぞれの電極ヘッド(6)の大きさを示すもので、電極ヘッド(6)に対する管電流の関係も前述の通りである。即ち、管電流に対して電極ヘッド(6)の大きさが過大であると電極ヘッド(6)の温度が下がりすぎてアークの立ち消えが生じ、過小であると熱容量が不十分で点灯時の電極構成物質の蒸発量が増大する。「$D_1\times L_1$」及び「$D_2\times L_2$」が前記範囲にあれば、アークの立ち消えもなく電極構成物質の蒸発量も抑制する事が出来る。なお、直流用の場合は、「Ｄ」「Ｌ」に添え数字「$_1$」「$_2$」を付して極性を区別した。

【００２４】

【発明の実施の形態】以下、本発明を好適な実施例を用いて説明する。図１は本実施例に係る交流用高圧水銀ランプ(A1)を示した図である。外囲器(1)は、アルゴンガス或いはクセノンガス又はこれらの混合ガスなどの必要ガス、水銀、ハロゲン(金属ハロゲンの形で封入されたり、ハロゲン化水銀或いは臭化メチレンのような形でで封入される。)などが封入された放電容器(2)とその両端から突出した細長の封止部(3)(4)とで構成される。

【００２５】放電容器(2)の中には対向する一対のタングステン製の電極(E)が配置されており、電極(E)の細径電極軸(7)はモリブデン箔(8)の一端部に溶接されている。そして、前記モリブデン箔(8)の他端部には外部リード(9)が溶接され、封止部(3)(4)から導出されている。本発明のタングステン電極(E)は、太径のタングステン棒から電極軸(7)を削りだした１本もので、電極軸(7)の直径は電極ヘッド(6)の太径部分(61)の50%～30%程度となっている。なお、交流用高圧水銀ランプ(A1)の電極(E)は、通常同一形状のものが使用されるので、同一番号を付して表した。

【００２６】前記交流用高圧水銀ランプ(A1)の電極(E)の例を図３～５に示す。これらは球面部分(63)の形状かせ若干相違するものの、基本的には太径の電極ヘッド(6)と電極ヘッド(6)から一体的に突設された細径の電極軸(7)とで構成されている。そして、前記電極軸(7)の反対側に位置する電極ヘッド(6)の先端部分が、先端に行く程次第に細くなる略円錐台状に形成され且つ前記円錐台部分(62)の先端が球面に形成されている。円錐台部分(62)のテーパ角度(θ)は、テーパ角度(θ)が20°～60°である。なお、円錐台部分(62)の斜面は直線に限られず、その母線が凹曲線或いは凸曲線を描いていてもよい。

【００２７】前記円錐台部分(62)の先端部分の球面部分(63)は、例えば電極ヘッド(6)の先端部分を円錐状に切削加工し、その円錐部分(65)の先端を溶融し、その表面張力で球面状にする事で形成される。この場合、円錐部分(65)のテーパー角度(θ)と溶融量の違いによってその形状が相違する。図３は先端の溶融量が少なく球面部分(63)が球体又は回転楕円体の一部のような場合であり、図４は先端の溶融量が適正で半球の場合、図５は先端の溶融量が多すぎて球面部分(63)が飛び出した状態で、基部(64)が若干くびれており、球面部分(63)の一部が円錐台部分(62)に一体的に接続しているような場合である。即ち、基部(64)の直径(d2)＜最大直径(d1)となる。勿論、球面部分(63)の形状はこれに限られず、例えば円錐台部分(62)の先端に一体的に連なる基部(64)の部分に円柱状部分(図示せず)があり、その先端が球面に形成されている場合も含む。前記球面部分(63)の形状は当然真円である必要はなく、表面に凹凸があってもよい事は言うまでもない。

【００２８】前記球面部分(63)とランプ電力(W)との間には、球面部分(63)の適正値を決定する「0.0015≦(d1)／(W)≦0.005」なる関係が実験的に導き出されている。より好ましくは「0.0025≦(d1)／(W)≦0.0035」である。ここで、(d1)は球面部分(63)の最大直径である。ランプ電力(W)の単位はワットである。また、管電流と電極ヘッド(6)の大きさとの間にも、電極ヘッド(6)の適正な大きさを決定する関係が実験的に導き出されている。この関係は最大外径をD、電極ヘッド(6)の長さをLとしたとき、「0.75×I≦D×L≦2.9×I」の範囲にあることが好ましいと実験的に確かめられている。

【００２９】前記放電容器(2)に封入される水銀量は、0.2mg/mm³以上であり、ハロゲン濃度は1.1×10^{-4}以上3.2×10^{-3} μmol/mm³以下である。ハロゲン濃度はイオン濃度で表される。

【００３０】次に、交流点灯時の作用に付いて説明する。一対の外部リード棒(9)を交流電圧を印加すると対向電極(E)間で交互にアークが飛び点弧される。アークはマイナスに印加された電極(E)の先端の球面部分(63)からプラスに印加された電極(E)に向かって飛ぶが、アークは一般的に両対向電極(E)の先端の球面部分(63)の最も近い部分間で飛ぶ。両対向電極(E)の先端部分には円錐台部分(62)が形成されているので先端部分は絞られており且つその先端には球面部分(63)が形成されているので、アークは球面部分(63)間に略限定されて安定して飛ぶ事になる。その結果アークは安定し、チラツキが解消される。

【００３１】アークが球面部分(63)間で飛ぶと、球面部分(63)を始め電極ベッド(6)はアークの熱で急速に加熱され、0.2mg/mm³以上の水銀量が封入された放電容器(2)にあってはアークの輝点温度は7500ｋにも達する。その結果、アークの輝点(10)に近い球面部分(63)はその高熱に曝されて高温になるが、球面部分(63)の熱は、十分な質量を持ちヒートシンクとして十分な作用をする電極ヘッド(6)、特に太径部分(61)に伝達され、球面部分(63)の温度上昇を抑制する。高温に曝された前記球面部分(63)は、点灯中たとえその表面が若干溶融しても本来の形状が球面状であるので、その形状が大きく変化することがない。（例えば、先端が三角錐状の電極であれば、三角錐の部分が溶けることによって先端が丸くなり、先端形状が大幅に変化する。）従って、点灯中に球面部分(63)の表面が若干溶融しても電極間距離が変わるようなことがなく、安定なアーク発生が維持される。

【００３２】ここで、図３のように球面部分(63)が球体又は回転楕円体の一部のような形状である場合或いは図４のように半球状或いは半回転楕円体状である場合、球面部分(63)から円錐台部分(62)を通ってヒートシンクとしての主要な働きをなす太径部分(61)への熱の移動がスムーズに行われ、球面部分(63)の過熱を回避しやすい。その反面、図５のように球面部分(63)が円錐台部分(62)から突き出した状態となっていないので、アークがプラス側の電極(E)の円錐台部分(62)に飛ぶ確率は図５の場合より若干多いと考えられる。

【００３３】一方、図５の場合は球面部分(63)が円錐台部分(62)から突き出したような状態であるので、図３、４の場合に比べてアークが飛ぶ球面部分(63)の面積が大きい事、球面部分(63)が円錐台部分(62)から突き出しているので、円錐台部分(62)に比べて対向した球面部分(63)同士がより接近した状態になる事から、球面部分(63)間でアークがより飛びやすくなる。その反面、球面部分(63)の基部(64)が絞られた状態となるので、基部(64)がネックとなり太径部分(61)への熱の移動が図３、４に比べて若干遅れる事になり、球面部分(63)が若干過熱されやすくなる傾向にある。いずれにしても図３～５の電極(E)の球面部分(63)の本来の形状が球面状であるので、その形状が大きく変化することがなく、点灯中の電極間距離の変化は非常に小さいものとなる。

【００３４】次に、直流用用高圧水銀ランプ(A2)を図２に従って説明する。説明の煩雑さを避けるため交流用高圧水銀ランプ(A1)と同じ部分は同一の符号を付し、異な

る部分を中心に説明する。異なる部分は、電極(-E)(+E)の形状が交流用高圧水銀ランプ(A1)のそれと異なること、電子の流れが陰極(-E)から陽極(+E)に連続して流れる点だけである。その他の点は交流用高圧水銀ランプ(A1)と同じである。

【００３５】陰極(-E)は、交流用と同じものが使用されるが、陽極(+E)は点灯中、常時、熱電子が陽極(+E)の対向面(12)に衝突して陽極(+E)を過熱するため陰極(-E)に比べて質量の大きいものが用意される。一方、陰極(-E)の球面部分(63)の近傍に高温の輝点(10)が現れ、球面部分(63)を加熱するが、局部加熱になるので陽極(+E)より小さい質量のもので足る。

【００３６】陽極(+E)の形状は、前述のように交流用と同じ形状のものでもよいが、直流の場合は連続的に熱電子を受けるだけであるので、円錐台部分(62)がなく太径部分(61)の先端に直接球面部分(63)が形成されているような電極(6a)でもよい。図２の場合は、後者の電極ヘッド(6a)を採用している。

【００３７】次に、直流点灯時の作用に付いて説明する。一対の外部リード棒(9)を印加すると陽極側(-E)から陰極(+E)側にアークが飛び点弧される。この場合もアークは一般的に両対向電極(-E)(+E)の先端の球面部分(63)(12)間の最も近い部分で飛ぶ。陰極(-E)の先端部分は前述のように円錐台部分(62)が形成されてその先端部分が絞られており且つその先端には球面部分(63)が形成されているので、アークの起点(11)は球面部分(63)内で安定的に発生し、アークの移動が解消される。

【００３８】交流の場合と同様に球面部分(63)は0.2mg/mm³以上の水銀量が封入されているので、アークが球面部分(63)上で発生すると、高温の輝点(10)によって陰極(-E)の球面部分(63)は加熱される。しかしながら球面部分(63)の熱は、十分な質量を持ちヒートシンクとして十分な作用をする電極ヘッド(6)、特に太径部分(61)に伝達され、球面部分(63)の温度上昇は抑制される。そして交流の場合と同様に高温に曝された前記球面部分(63)は、点灯中たとえその表面が若干溶融しても本来の形状が球面状であるので、その形状が大きく変化することがない。

【００３９】一方、陽極(+E)側では、電極ヘッド(6a)の対向先端面(12)は球面に形成されているので、概ねアークは対向先端面(12)の頂部に向かって安定的に飛ぶ。このように、円錐台部分(62)とその対向先端部に球面部分(63)を有する陰極(+E)と、球面部(12)を持つ陽極(+E)の協働作用によりアークは安定して発生する。また、点灯中の電極間距離の変化も交流の場合と同様非常に小さいものとなる。

【００４０】

【発明の効果】以上述べたように本発明により、高効率と長寿命とフリッカーレスのいずれの性能も満足する光源を提供することができた。。

【図面の簡単な説明】

【図１】本発明における交流用高圧水銀ランプの実施例の断面図。

【図２】本発明における直流用高圧水銀ランプの実施例の断面図。

【図３】本発明に使用される電極の第１実施例の正面図。

【図４】本発明に使用される電極の第２実施例の正面図。

【図５】本発明に使用される電極の第３実施例の正面図。

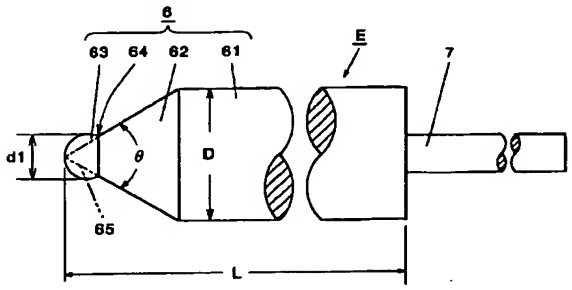
【図６】従来例１の断面図。

【図７】従来例２の断面図。

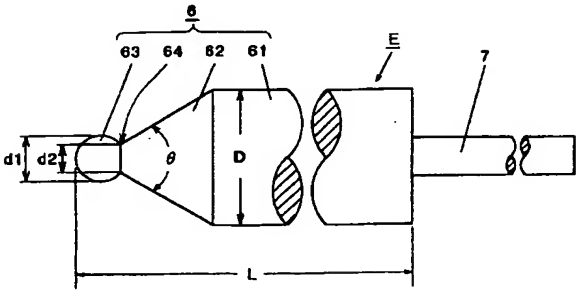
【符号の説明】

(E)　ランプ用電極
(1)　外囲器
(2)　放電容器
(3)(4)　封止部
(6)　電極ヘッド
(7)　電極軸
(61)　太径部分
(62)　円錐台部分
(63)　球面部分

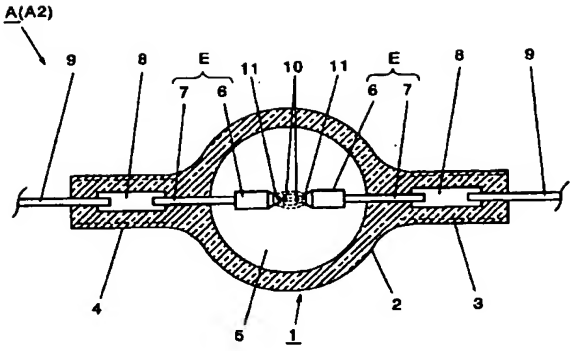
【図４】



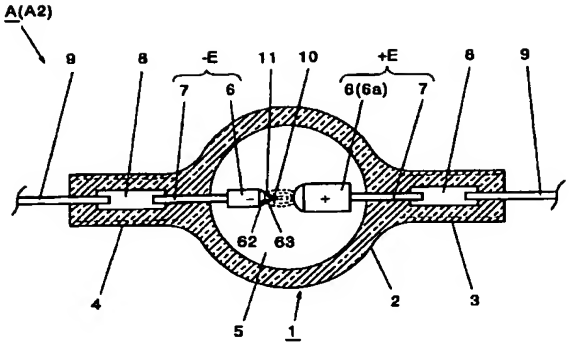
【図５】



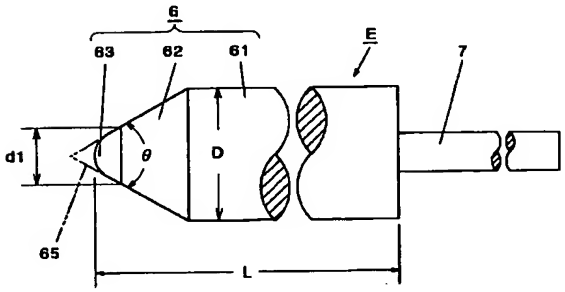
【図１】


A(A2)
9
8
E
11
10
11
E
8
9
7
6
6
7
4
5
1
2
3

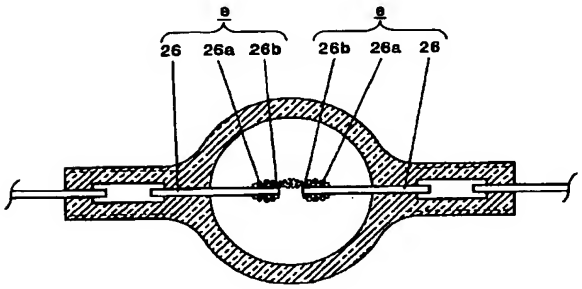
【図２】


A(A2)
9
8
-E
11
10
+E
8
9
7
6
6(6a)
7
62
63
4
5
1
2
3

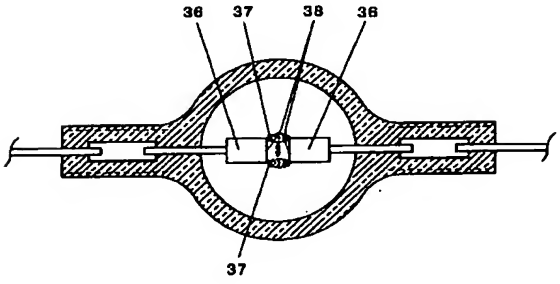
【図３】


6
63
62
61
E
7
d1
θ
D
65
L

【図６】


8
8
26
26a
26b
26b
26a
26

【図７】


36
37
38
36
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